US Army Corps of Engineers
North Central Division

GREAT LAKES LEVELS

Update Letter No. 78 January 3, 1992

1991 ANNUAL SUMMARY

A retrospective look at 1991 indicates a year of relatively average precipitation and average temperature conditions for the Great Lakes Basin. There were some concerns about high water levels on Lake Ontario during mid-January to May. This necessitated considerable overdischarging to mitigate the potential for flooding along the lake shoreline. The levels of all the lakes were generally higher than those of last year with the exception of Lake Ontario, which experienced below-average conditions during the second half of the year.

In this issue of the Update Letter, 1991 will be reviewed with respect to precipitation, lake levels, storms, regulation of Lakes Superior and Ontario outflows, commercial navigation, Levels Reference Study, Great Lakes environmental projects, the International Great Lakes Datum, and a reflection on the past year's Update Letters.

Precipitation

Across the Great Lakes Basin, the winter of 1990-91 began with below-average temperatures in December-January. Precipitation was far above-average for December 1990; in 1991 above-average precipitation occurred for the months of March through May, July, October, and December, with the rest of the months experiencing below-average or average precipitation. The basin snowpack was far below average at the time of the spring snowmelt. The total basin-wide precipitation for 1991 was 35 inches, about 3 inches above average. Figure 1 compares monthly precipitation for 1991 and 1990 to the long-term average for the entire basin.

Lake Levels

The "Monthly Bulletin of Lake Levels for

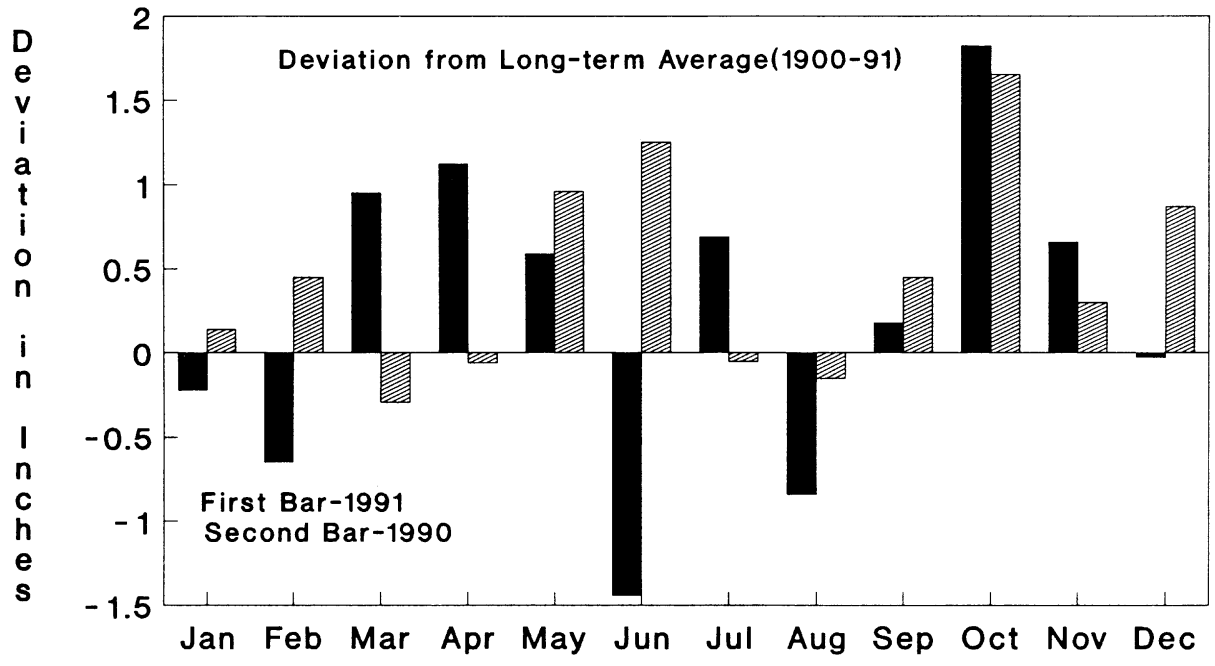


Figure 1. Monthly Deviations of 1990 and 1991 Precipitation for the Great Lakes Basin.

the Great Lakes," within which this Update Letter is enclosed, graphically shows the fluctuation of water levels on the Great Lakes for 1991. Generally, it can be seen that the level of Lake Superior remained below its average level throughout 1991; Lakes Michigan-Huron were near average; Lakes St. Clair and Erie were above average the entire period;and Lake Ontario started the year well above-average, but finished the year below average.

Lake Superior's level followed its normal seasonal cycle, declining through the winter and beginning its seasonal rise in March. At its lowest level of the year, the lake was about 3-1/2 inches below its March long-term average level. Due to above-average precipitation in the spring and early snowmelt, the lake rose to within 1 inch of its long-term average levels in April and May. A lack of sustained snowmelt, due to the below-average snow cover and a warm spring and a dry August, resulted in the lake peaking in July, 2 months earlier than average. Heavy precipitation on the basin in the fall and below-average evaporation from the lake kept the lake at nearly a constant elevation through the remainder of the year. Lake Superior ended the year at its long-term average level.

Lakes Michigan-Huron began 1991 at their long-term average level. The lakes were at their lowest level of the year in February, at which time they were 1-1/2-inches below the February long-term average. As the lakes began their normal spring rise, above-average precipitation caused the levels to go above their long-term average in April. The lakes continued to rise into June, and they peaked about 2 inches above the June long-term average level. A dry summer caused the lakes to decline below their average levels in August. The lake continued to decline into October. At that time, near record high precipitation arrested the normal decline, and the lakes ended the year at average.

Lakes St. Clair and Erie followed very similar patterns of fluctuation during 1991. Both lakes began the year well above their average levels. Record high precipitation in December 1990 caused the lakes to rise in January, when they would usually be continuing to decline. Though precipitation was below average during the winter months, warm conditions caused most of the water to enter the lake instead of being stored on the basin as snow and ice. With little snowmelt in the spring, above-average precipitation in April and May created only a small rise in levels. The two lakes peaked in June, about 10 inches above average. Dry weather from June to September caused a rapid drop in the level of Lake Erie. Above- average precipitation in the fall and increased inflow from upstream lakes and low evaporation rates stalled the normal decline in November and December.

Lake Ontario began 1991 about 0.7 foot above average and rose sharply in January. The rise continued until the lake peaked in May. There followed a significant decline in levels with the lake falling below average in August. This trend continued during the rest of the year. The lowest monthly average was in November at a level of 243.43 feet. This was the lowest the lake had been since April 1965. The lake ended 1991 below average.

The peak levels for 1991 were higher than those of 1990 for all the lakes. All the lakes attained their seasonal peaks earlier than usual, with the exception of Lake Erie.

Storms

1991 was a quiet year in relation to lake-related flooding. A storm on March 28 caused the water level at Buffalo to rise about 5 feet. This amount of storm rise is given a chance of occurring once in about 3 years. However, there was no flooding damage related from this storm.

Lake Regulation

The International Joint Commission (IJC) has the authority to regulate the outflows from Lakes Superior and Ontario. The

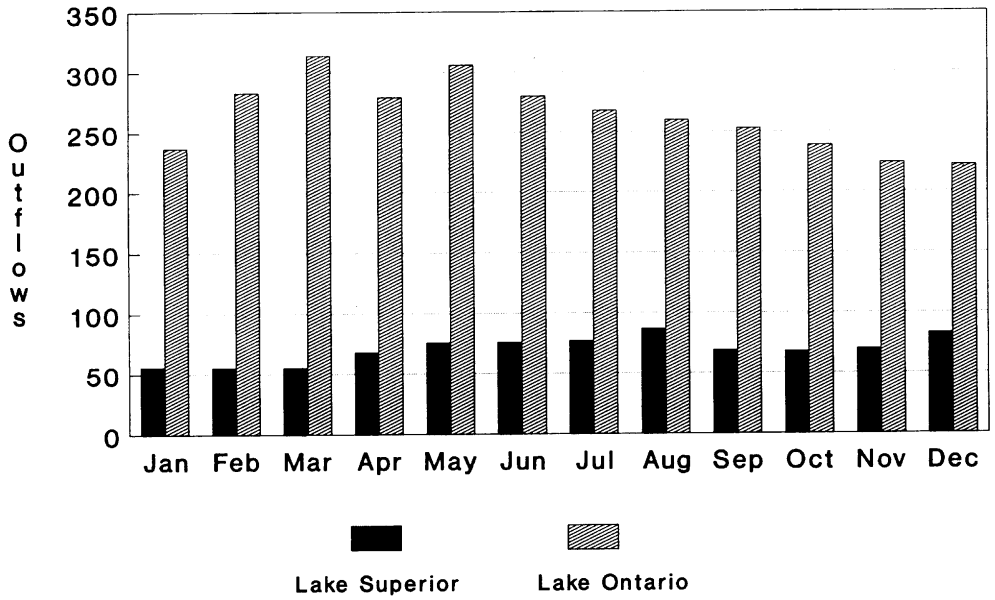


Figure 2. 1991 Regulated Outflows (in 1,000 cfs) from Lakes Superior and Ontario.

other lakes are unregulated. Update Letters Nos. 61, 63, 75, and 77 discussed in detail the regulation plans.

In 1991, Lake Superior outflows were ssentially those specified by Regulation Plan 1977-A (Figure 2). Due to the imbalance of the levels of Lakes Superior and Michigan-Huron (Lake Superior, low; Lakes Michigan-Huron, high) and the below-average level of Lake Superior, the plan was generally attempting to hold water on Lake Superior. This resulted in below-average Lake Superior outflows for much of the year. The minimum allowable outflows were maintained during January through March. During August, some additional water was discharged to accommodate flow measurements that were made as part of a continuing program to verify the rating equations for the Compensating Works on the St. Mary's River. Throughout the year, the setting in the Compensating Works was kept at one-half gate open, while 400 cfs of water flowed through Gate No. 1 to satisfy the fish habitat located on the north side of the remedial wall. The flow changes from month to month were accomplished by varying the amount of water allocated to hydropower production.

The regulation plan for Lake Ontario is Plan 1958-D. The outflows prescribed are influenced by precipitation over the basin (determining the amount of water flowing into the lake from its own basin), the level of the upstream lakes (determining the water to flow in from Lake Erie), the levels of Lake Ontario, and those downstream at Montreal (Figure 2).

At the end of December 1990, Lake Ontario was about 6 inches above average and continued to rise rapidly above its average. The largest change occurred in late December due to heavy rain. The lake level rose by 6 inches in 1 week. The lake level deviation from its long-term average reached a maximum of about 17 inches by January 25 and remained at that amount above average for 3 more weeks until mid-February.

In response to high water supplies and concerns of flooding, the International St. Lawrence River Board initiated a series of weekly overdischarges, starting from December 15, 1990, and continuing until April 5, 1991. The board then began to underdischarge April 6 through May 3 to protect the Montreal area from possible flooding at the time of Ottawa River freshet. The high supplies, though varied, continued until May and then the trend abruptly reversed. The lake peaked on May 3 at 246.66 feet, about 16 inches above average. The overdischarging was then resumed for another 2 weeks, until there was a clear indication that supplies were near average. In order to eliminate the deviations from plan flows, the board then adopted an underdischarge strategy which continued until August 30, at which time there was still 32,000 cfs-weeks (equivalent to about 1 inch on the lake). The board then followed Plan 1958-D September through mid-November. Some overdischarges were authorized November 16-December 13 to improve the low-level conditions in Montreal Harbor. The accumulation and elimination of the outflow deviations are within the board's discretionary authority to protect the interests of power, navigation, and riparians.

Commercial Navigation

Commercial navigation trends were somewhat mixed on the Great Lakes in 1991 compared to the previous year. Through October 1991, tonnage at the Soo Locks increased 3.6 percent over the comparable figure for 1990. On the St. Lawrence Seaway, tonnage decreased 3.8 percent from last year in comparing the statistics through September. A feature article in Update Letter No. 67, February 4, 1991, covered the various navigation facilities, both U.S. and Canadian, on the Great Lakes and their connecting channels and the related cargo statistics. Through October 1991, a total of 3,996 cargo vessel transits passed through the Soo Locks. Of these, 2,144 were U.S.-flagged vessels, 1,618 were Canadian-flagged, and 234 were foreign (ocean-going or "salties"). Of the U.S. and Canadian vessels, some of these "lakers" made a number of trips during the navigation season. The total number of cargo vessel transits was 91 more than that of last year in comparing the October totals of 1990 and 1991. The U.S. and Canadian vessels carried about 48 and 21 million tons of cargo, respectively. The foreign vessels carried about 2 million tons. In addition to the cargo vessels, there were also 6,851 transits for other types of vessels, such as pleasure craft, Coast Guard, and scientific/research vessels. This was 497 transits less than 1990 (statistics through October 1990).

On the St. Lawrence River, the commercial navigation season opened on March 26, with the passage of the Silver Isle (Figure 3) through Snell Lock. The following data are for the Eisenhower Lock in the International Section of the St. Lawrence River. By the end of September 1991, there were 1,355 transits of laker cargo vessels and 588 transits of salties. These show an increase of 119 laker transits and a decrease of 38 ocean vessel transits in

Figure 3. Upbound Laker Vessel Silver Isle

comparison to the total September statistics of 1990. The total transits were 81 more this year than last year.

International Joint Commission

The IJC Levels Reference Study Board accomplished several of its planned goals during 1991 and held 12 meetings during the year. The board experienced some change in personnel during this period and now consists of the following:

U.S. Members

John P. D'Aniello, Corps of Engineers U.S. Cochair
Joseph Hoffman, State of Pennsylvania
Kent Lokkesmoe, State of Minnesota
Cliff Sasfy, Great Lakes Coalition and Citizens Advisory Committee
Frederick Brown, Citizens Advisory Committee

Canadian Members

E. Tony Wagner, Environment Canada, Canadian Cochair
Andre Harvey, Province of Quebec
Maurice Lewis, Province of Ontario
Phillip Weller, Great Lakes United and Citizens Advisory Committee
Peter B. Yeomans, Citizens Advisory Committee
Neil R. Fulton, Binational Study Director

The Citizens Advisory Committee, which consists of 18 members, 9 each from the United States and Canada, has been very active in meeting and advising the board. They have also been instrumental in arranging for a number of tours in conjunction with the board's public meetings. Public meetings were held in 1991 as follows:

May 21 - Alexandria Bay, New York
May 29 - Cleveland, Ohio
Jun 27 - Port Rowan, Ontario
Sep 5 - Duluth, Minnesota
Sep 30 - Traverse City, Michigan

The board has appointed four working committees to carry out the elements of the formal work plans and study schedules.

The Working Committees are as follows:

a. Public Participation and Information.
b. Land Use and Management.
c. Existing System Regulation, System-wide Regulation, and Crises Conditions.
d. Principles, Measures Evaluation, Integration, and Implementation .

The working committees made substantial progress in undertaking the technical work of the study during 1991. Phase II study funds total approximately $6 million, equally divided between the United States and Canada. The study is scheduled for completion in March, 1993, with a final report to the IJC for their use in responding to the August 1986 Reference Study from the United States and Canadian Governments.

Products completed by the Study Board in 1991 are as follows:

a. Summary of Alexandria Bay, New York, Public Meeting, May 21.
b. Basis of Comparison, Jun 10.
c. Strategy for Measures Evaluation, Jun 27.
d. Summary of Port Rowan, Ontario, Public Meeting, Jun 27.
e. Ad hoc Committee Report on Expectations, Jun 28
f. Summary of Duluth, Minnesota, Public Meeting, Sep 5.
g. Study Planning Objectives, Sep 30.
h. Measures for Examination, Nov15.

Copies of any of the board's products may be obtained from the Study Director:

Mr. Neil R. Fulton
72 Lyme Road
Hanover, NH 03755-1290
Telephone: (603) 646-4685

The U.S. Army Corps of Engineers continued extensive work on a geographic information system (GIS) for the Great Lakes Basin. The riparian survey of 1989-90 has been input to a data base and linked to the GIS. Queries of the survey results have begun in support of the Reference Study. Input of the land use portion, developed from recent aerial photography, is nearly complete. The GIS will be used to support detailed site studies for the Levels Reference Study.

The U.S. Army Corps of Engineers also continued investigations into improving and/or expanding the regulation of Great Lakes water levels. These studies include reviewing and proposing modifications to the present plans of regulation on Lakes Superior (Plan 1977-A) and Ontario (Plan 1958-D). The impact and feasibility of expanding regulation to the other Great Lakes are also being assessed as part of the IJC Levels Reference Study.

Public Meetings

In September 1990, the IJC presented a policy to its boards that they implement public meetings at least annually. The St. Lawrence River and Niagara Boards held their public meetings on June 27, and September 12, 1991, at Kingston, Ontario, and Fort Erie, Ontario, respectively. The public meetings were successful as attested by the attendance of a number of individuals, representatives from interest groups, and government agencies. The public was presented with an overview of regulation and other water issues prior to the question-and-answer session. The feedback received from the public related to the regulation of Lake Ontario and to issues of the Niagara River demonstrated to the IJC and its boards that a judicious use and protection of the Great Lakes water resources could best be accomplished with an open discussion and continued dialogue with the public.

The Lake Superior Board held an open house in Sault Ste. Marie, Ontario on September 17, 1991. The board exhibited several large displays depicting the Great Lakes projects and programs. Brigadier General Patin inaugurated a permanent display board at the Soo Visitor's Center at Sault Ste. Marie, Michigan, that shows the responsibility of IJC and the U.S. Army Corps of Engineers from the Atlantic to the Pacific oceans. Subsequent Update Letters will provide the details of the future public meetings to be held in the U.S.

Environmental Aspects of the Great Lakes Basin

The Great Lakes Water Quality Agreement of 1978 has led to the designation of Areas of Concern (AOC) on the Great Lakes. Water-quality degradation at these AOCs has caused impairments to beneficial uses, such as fish consumption, advisories, beach closings, and water consumption limitations. Presque Isle Bay, Pennsylvania, was designated the 43d AOC in 1991.

State and provincial governments have been developing Remedial Action Plans (RAPs) for the restoration of impaired beneficial uses at areas of concern. The U.S. Army Corps of Engineers has supported

RAP development as a part of its missions of navigation maintenance and wetlands protection.

Contaminated bottom sediments are identified as a significant non-point source of pollution at almost every AOC. The USEPA's Assessment and Remediation of Contaminated Sediments (ARCS) program is a 5-year program which is evaluating and demonstrating methods for cleaning up Great Lakes contaminated sediments. The U. S. Army Corps of Engineers has been supporting the EPA's ARCS program and has conducted field demonstrations of innovative treatment technologies on contaminated sediments at the Buffalo River and Saginaw Bay in 1991. Additional technology demonstrations are planned for northwest Indiana; Sheboygan, Wisconsin; and Ashtabula, Ohio, in 1992.

Impact of New International Great Lakes Datum on Permit Processing

For a number of years, the U.S. Army Corps of Engineers has been working with the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, and several federal agencies in Canada under the auspices of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data to update the vertical datum plane for the Great Lakes. The current datum plane is the International Great Lakes Datum of 1955 (IGLD, 1955). This will be replaced by IGLD(1985) in January 1992. A workshop was held on November 20, 1991, in Ann Arbor, Michigan, to explain implementation of the new datum. Some details on this effort were outlined in Update Letter No. 76, November 4, 1991. The impact of the new IGLD(1985) and what it means to the IJC boards, the U. S. Army Corps of Engineers permit process, and the public were also discussed.

As most shoreline property owners on the Great Lakes and connecting channels know, the U.S. Army Corps of Engineers administers a regulatory permit program which oversees most work on the Nation's waterways and wetlands. The U.S. Army Corps of Engineers authority to regulate construction work, dredging, or other work in, over, or under navigable waters of the U.S. which would affect the course, conditions, or capacity of such waters is found in Section 10 of the Rivers and Harbors Act of 1899. In addition, Section 404 of the 1977 Clean Water Act gave the U.S. Army Corps of Engineers authority to regulate the placement of dredged or fill material into waters of the U.S., including wetlands. The limits of Section 10 and Section 404 jurisdiction on the Great Lakes and connecting channels are defined by the U.S. Army Corps of Engineers' Ordinary High Water Mark (OHWM), unless adjacent wetlands are present above the OHWM, in which case Section 404 jurisdiction includes the wetlands.

With the implementation of IGLD (1985), the limits of U.S. Army Corps of Engineers permit jurisdiction under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, for projects, will not physically change in extent. Instead, the numerical values representing the U.S. Army Corps of Engineers current OHWM elevations will be reassigned elevations referenced to IGLD (1985). Consequently, new permit applications submitted to the U.S Army Corps of Engineers should reference any water-level elevations on the drawings to IGLD (1985). To assist the public in applying for U.S. Army Corps of Engineers permits, the table below shows the current and new OHWM elevations, in feet, for the Great Lakes.

	IGLD 1955	IGLD 1985
Lake Superior	602.00	603.10
Lake Michigan	580.80	581.50
Lake Huron	580.80	581.50
Lake St. Clair	575.70	576.30
Lake Erie	572.80	573.40
Lake Ontario	246.80	247.30

For those individuals contemplating work on the connecting channels (St. Mary's, St. Clair, Detroit, Niagara, and St. Lawrence Rivers), OHWM elevations expressed in IGLD (1985) will be published sometime early in 1992. Until these elevations are available, permit applicants can continue referencing water-level elevations relative to IGLD (1955). Should you have questions regarding the implementation of IGLD 1985 or matters regarding the U.S. Army Corps of Engineers regulatory program in your area, contact your local U.S. Army Corps of Engineers District Office.

Update Letters

In 1991, we provided information in each Monthly Update on various Great Lakes-St. Lawrence River topics. These were in Update Letters as follows:

No. 67. Commercial Navigation on Great Lakes/St. Lawrence River.

No. 68. St. Mary's River Ice Boom.

No. 69. Lake Survey History Published.

No. 70. Recreational Boating and Water Sport.

No. 71. The Binational Approach of the IJC.

No. 72. Shoreline Property Ownership.

No. 73. Forecasting Great Lakes Water Levels.

No. 74. Precipitation on the Great Lakes.

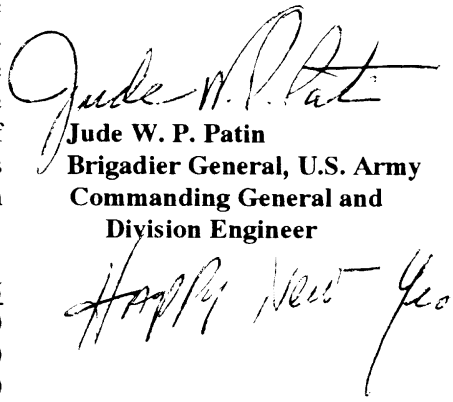
No. 75. Lake Ontario Regulation.

No. 76. International Great Lakes Datum.

No.77. Lake Ontario Regulation Plan Improvements.

No. 78. 1991 Annual Summary.

If you have a need for a copy of the past issues, you may contact the Detroit District, U.S. Army Corps of Engineers.



Jude W. P. Patin
Brigadier General, U.S. Army
Commanding General and
Division Engineer

Great Lakes Basin Hydrology

The precipitation, water supplies, and outflows for the lakes are provided in Table 1. For the precipitation, this includes the provisional for the past month, the year-to-date and the long-term average. Both the provisional and long-term average water supplies and outflows are also shown.

Table 1
Great Lakes Hydrology[1]

PRECIPITATION								
BASIN	DECEMBER				YEAR-TO-DATE			
	1991*	AVG.**	DIFF.	% OF AVG.	1991*	AVG.**	DIFF.	% OF AVG.
Superior	1.8	2.0	-0.2	90	35.2	30.2	5.0	117
Michigan-Huron	2.4	2.3	0.1	104	36.2	31.9	4.3	113
Erie	2.4	2.6	-0.2	92	31.5	34.8	-3.3	91
Ontario	3.0	2.9	0.1	103	33.4	35.0	-1.6	95
Great Lakes	2.3	2.3	0.0	100	35.0	32.2	2.8	109

LAKE	DECEMBER WATER SUPPLIES***		DECEMBER OUTFLOW[3]	
	CFS[2]	AVG.[4]	CFS[2]	AVG.[4]
Superior	-13,000***	-24,000***	83,000	73,000
Michigan-Huron	102,000	29,000	187,000[5]	183,000
Erie	23,000	17,000	200,000[5]	199,000
Ontario	27,000	27,000	222,000	232,000

**Estimated (inches) **1900-89 Average (inches)
***Negative water supply denotes evaporation from lake exceeded runoff from local basin.

[1]Values (excluding averages) are based on preliminary computations.
[2]Cubic Feet Per Second [3]Does not include diversions [4]1900-89 Average (cfs)
[5]Reflects effects of ice/weed retardation in the connecting channels.

For Great Lakes basin technical assistance or information, please contact one of the following Corps of Engineers District Offices:

For NY, PA, and OH:
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